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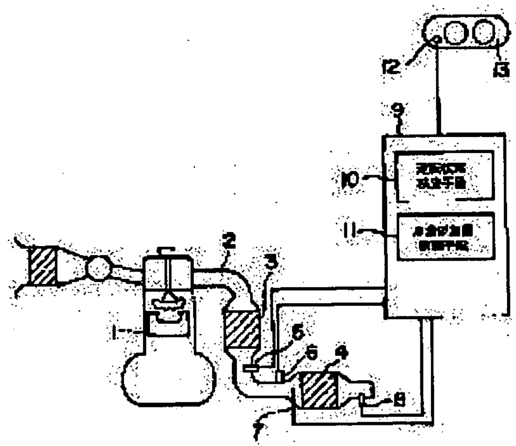
(54) EXHAUST EMISSION CONTROL DEVICE FOR INTERNAL COMBUSTION ENGINE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an exhaust emission control device for an internal combustion engine, capable of purifying NOx in a range of operation areas as wider as possible as compared with that in the past.

SOLUTION: An NOx absorption and reduction catalyst 3 capable of occluding NOx when the air-fuel ratio of exhaust gas is lean, and of emitting and reducing occluded NOx when the oxygen concentration in exhaust gas is lowered, is provided for the exhaust passage of a lean combustion type internal combustion engine, and the engine is also provided with an urea selective reducing catalyst 4 capable of letting reduction take place while urea is being added, and it is so devised that exhaust emission control is performed by two catalysts while they are mutually compensating for exhaust emission control roughly in the whole range of operation areas for the internal combustion engine.



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CLAIMS

[Claim(s)]
[Claim 1] It is NOx when the air-fuel ratio of the exhaust gas discharged from the internal combustion engine by the flueway of a lean combustion formula internal combustion engine is RIN. NOx which carried out occlusion, and carried out occlusion when the oxygen density in exhaust gas fell NOx emitted and returned Exhaust emission control device of the internal combustion engine characterized by having an occlusion reduction-type catalyst and the ammonium-compound selection reduction catalyst to which selection reduction is performed by ammonium-compound addition.
[Claim 2] The operational status of the internal combustion engine detected by the aforementioned operational status detection means while having an operational status detection means to detect the operational status of an internal combustion engine is followed, and it is Above NOx. Exhaust emission control device of the internal combustion engine according to claim 1 characterized by having the means for switching which switch an exhaust air gas stream to either of an occlusion reduction-type catalyst and an ammonium-compound selection reduction catalyst.
[Claim 3] Above NOx Exhaust emission control device of the internal combustion engine according to claim 1 or 2 characterized by having arranged the occlusion reduction-type catalyst and the aforementioned ammonium-compound selection reduction catalyst in series to the flueway.
[Claim 4] The aforementioned ammonium-compound selection reduction catalyst is set to a flueway, and it is Above NOx. Exhaust emission control device of the internal combustion engine according to claim 3 characterized by having arranged to the downstream of an occlusion reduction-type catalyst.
[Claim 5] The aforementioned ammonium-compound selection reduction catalyst is set to a flueway, and it is Above NOx. Exhaust emission control device of the internal combustion engine according to claim 3 characterized by having arranged to the upstream of an occlusion reduction-type catalyst.
[Claim 6] Above NOx Exhaust emission control device of the internal combustion engine according to claim 1 or 2 characterized by having arranged the occlusion reduction-type catalyst and the aforementioned ammonium-compound selection reduction catalyst in parallel with a flueway.
[Claim 7] It is the exhaust emission control device according to claim 3 which is equipped with the bypass way which bypasses the catalyst arranged at the upstream and shows exhaust gas to the catalyst of a downstream, and is characterized by the aforementioned means for switching switching an exhaust air gas stream by opening and closing a bypass way.
[Claim 8] A flueway is made to branch to the 1st parallel flueway and 2nd parallel flueway mutually, and it is Above NOx to the 1st flueway. Exhaust emission control device of the internal combustion engine according to claim 6 characterized by having arranged the occlusion reduction-type catalyst, having arranged the aforementioned ammonium-compound selection reduction catalyst to the 2nd flueway, and having arranged the change-over valve to the branch point of the 1st flueway of the above, and the 2nd flueway as the aforementioned means for switching.
[Claim 9] NOx in the exhaust gas which flows into the aforementioned ammonium-compound selection reduction catalyst Exhaust emission control device of an internal combustion engine given in either of the claims 1-8 equipped with an amount determination means of addition ammonium compounds to presume the amount of ammonium compounds which should be added from an amount and the inhalation air content of an internal combustion engine to the aforementioned ammonium-compound selection reduction catalyst.
[Claim 10] The exhaust emission control device of the internal combustion engine [equipped with an ammonium-compound detection means to detect the ammonium compound which flows out of the aforementioned ammonium-compound selection reduction catalyst, and the control means which correct to a proper addition the amount of ammonium compounds which should be added from the amount of ammonium-compound detection detected with this ammonium-compound detection means] according to claim 9.

[Claim 11] The exhaust emission control device of an internal combustion engine given in either of the claims 1-10 equipped with a degree detection means of catalyst temperature to detect the temperature state of an ammonium-compound selection reduction catalyst, and the ammonium-compound addition control means which fluctuate the ammonium-compound addition to an ammonium-compound selection reduction catalyst with the detected degree of catalyst temperature.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] NOx in the exhaust gas which this invention requires for the exhaust emission control device of an internal combustion engine, and is especially discharged from the internal combustion engine of a lean combustion formula etc. -- it is related with the equipment to purify
[0002]
[Description of the Prior Art] The equipment indicated by patent No. 2605580 is known as an exhaust emission control device of a lean combustion formula internal combustion engine.
[0003] This equipment is NOx when the air-fuel ratio of the flowing exhaust gas is RIN. NOx absorbed when it absorbs and the oxygen density of the flowing exhaust gas was reduced It is equipment which has arranged the NOx absorbent to emit to the flueway, and in order to reduce the oxygen density of exhaust gas, rich spike control which injects fuel in an internal combustion engine and generates a unburnt gas (reducing agent) is performed. This is NOx. The reducing agent for purification is NOx at an internal combustion engine course. It means that an absorbent is supplied.
[0004]
[Problem(s) to be Solved by the Invention] Although there is a request of wanting to operate in the state of RIN under high rotation and a heavy load by the case where an internal combustion engine is a lean combustion formula, with the exhaust emission control device which supplies a reducing agent from an internal combustion engine which was described above, at such operational status, it is NOx about a reducing agent by rich spike. An absorbent (NOx catalyst) cannot be supplied.
[0005] It is because trouble will cause combustion of fuel and a smoke will occur, if such rich conditions are formed, when an internal combustion engine is operated by the high rotation heavy load and RIN combustion, although it is necessary to extract a throttle and to reduce an inhalation air content in order to make an air-fuel ratio rich.
[0006] Then, although what is necessary is to give up RIN combustion and just to perform combustion by SUTOIKI (theoretical air fuel ratio), improvement in the mpg by RIN combustion cannot be aimed at by making an internal combustion engine into a lean combustion formula.
[0007] Moreover, at the selection reduction catalyst which uses such HC and H as a reducing agent although preparing the selection reduction catalyst which uses HC and H as a reducing agent is also considered, it is NOx in a high rotation heavy load state because of an elevated temperature. The rate of purification is low.
[0008] It is NOx at an all operating range since it is such. It was difficult to purify. It was made in view of such a point, it compares with the former, and this invention is NOx at the largest possible operating range. The exhaust emission control device of the internal combustion engine which can purify is offered a technical problem.
[0009]
[Means for Solving the Problem] this invention took the following meanses in order to solve the aforementioned technical problem. That is, the exhaust emission control device of the internal combustion engine of this invention is NOx when the air-fuel ratio of the exhaust gas discharged by the flueway of a lean combustion formula internal combustion engine from the internal combustion engine is RIN. NOx which carried out occlusion, and carried out occlusion when the oxygen density in exhaust gas fell It is characterized by having the NOx occlusion reduction-type catalyst which emits and returns, and the ammonium-compound selection reduction catalyst to which selection reduction is performed by ammonium-compound addition.
[0010] The internal combustion engine with which this invention is applied is the diesel power plant and gasoline engine of a lean combustion formula, and contains the engine of a cylinder-injection-of-fuel formula. NOx An occlusion reduction-type catalyst is NOx when the internal combustion engine is operated under RIN combustion of a

high rotation heavy load. NOx absorbed by the absorbent Since it is not returned by the catalyst and a NOx absorbent is not returned, it is NOx. Purification becomes impossible. However, an ammonium-compound selection reduction catalyst functions under the service condition of a high rotation heavy load, and it is NOx. It purifies. Therefore, NOx It compares, when only an occlusion reduction-type catalyst is established, and it is NOx. The operating range which can purify spreads.

[0011] In addition, NOx Although this invention was made on the assumption that the case where a reducing agent is supplied to an occlusion reduction-type catalyst via an internal combustion engine, even if it is equipment of the type which supplies a reducing agent to the flueway connected to the internal combustion engine, it does not interfere with applying this invention at all.

[0012] If it has the means for switching which switch an exhaust air gas stream to either of the aforementioned NOx occlusion reduction-type catalyst and an ammonium-compound selection reduction catalyst according to the operational status of the internal combustion engine detected by the aforementioned operational status detection means while having an operational status detection means to detect the operational status of an internal combustion engine here, operational status is followed and it is NOx. The suitable catalyst for purification can be chosen.

[0013] For example, it is Above NOx when the operational status detected with the operational status detection means is below a predetermined high rotation heavy load value. An occlusion reduction-type catalyst is chosen, and when the detected operational status exceeds a predetermined high rotation heavy load value, an ammonium-compound selection reduction catalyst is chosen.

[0014] In addition, the operational status which should be detected is NOx. It is a operating range used as the reduction impossible field of an occlusion reduction-type catalyst, and exhaust air purification by the ammonium-compound selection reduction catalyst is performed as reduction being impossible here at the time of predetermined high rotation heavy load operational status. Therefore, in order to detect such operational status, they are NOx(es), such as an inhalation air content besides an engine rotational frequency, an engine load, or both sides, and throttle opening. The parameter which can show directly or indirectly the reduction impossible field of an occlusion reduction-type catalyst can be used.

[0015] Here, it is Above NOx. An occlusion reduction-type catalyst and the aforementioned ammonium-compound selection reduction catalyst can be arranged in series to a flueway. In this case, the aforementioned ammonium-compound selection reduction catalyst is set to a flueway, and it is Above NOx. You may arrange to the downstream of an occlusion reduction-type catalyst, the aforementioned ammonium-compound selection reduction catalyst is set to a flueway, and it is Above NOx. You may arrange to the upstream of an occlusion reduction-type catalyst.

[0016] Thus, when arranging in series, it is good to switch an exhaust air gas stream by having the bypass way which bypasses the catalyst arranged at the upstream and shows exhaust gas to the catalyst of a downstream, and opening and closing a bypass way by the aforementioned means for switching.

[0017] Moreover, the above NOx It is also possible to arrange an occlusion reduction-type catalyst and the aforementioned ammonium-compound selection reduction catalyst in parallel with a flueway.

[0018] When arranging in parallel, a flueway is made to branch to the 1st parallel flueway and 2nd parallel flueway mutually. It is Above NOx to the 1st flueway. An occlusion reduction-type catalyst is arranged and the aforementioned ammonium-compound selection reduction catalyst is arranged to the 2nd flueway. as the aforementioned means for switching A change-over valve is arranged to the branch point of the 1st flueway of the above, and the 2nd flueway, and either of the 1st flueway and the 2nd flueway can be chosen by the change by the change-over valve according to an operation situation.

[0019] An operation situation is embraced by considering as the above composition, and it is NOx. It functions in the form which an occlusion reduction-type catalyst and an ammonium-compound selection reduction catalyst complement mutually, and suit. Therefore, as compared with the case of only one exhaust air purification catalyst, exhaust air purification can be performed by the wide range possible operating range.

[0020] Furthermore, NOx in the exhaust gas which flows into the aforementioned ammonium-compound selection reduction catalyst If the exhaust emission control device which consists of each aforementioned composition is equipped with an amount determination means of addition ammonium compounds to presume the amount of ammonium compounds which should be added from an amount and the inhalation air content of an internal combustion engine to the aforementioned ammonium-compound selection reduction catalyst, the amount of ammonium compounds which should be added can be determined easily.

[0021] Furthermore, if it has an ammonium-compound detection means to detect the ammonium compound which flows out of the aforementioned ammonium-compound selection reduction catalyst, and the control means which correct to a proper addition the amount of ammonium compounds which should be added from the amount of ammonium-compound detection detected with this ammonium-compound detection means, the amount of addition

ammonium compounds can be controlled more to accuracy, and more effective exhaust air purification can be performed. In addition, a urea, an ammonium carbamate, etc. are mentioned as an ammonium compound as a reducing agent used by the ammonium-compound selection reduction catalyst. Each composition of this invention explained above can be combined as mutually as possible.

[0022]

[Embodiments of the Invention] Hereafter, the operation gestalt of this invention is explained, referring to a drawing. In addition, in the following examples, it is the case where a urea is used as an ammonium compound.

[0023] The example shown in <operation gestalt 1> drawing 1 is NOx to the exhaust pipe 2 of the lean combustion formula gasoline engine 1 which is a cylinder-injection-of-fuel formula. It is the example which has arranged the occlusion reduction-type catalyst 3 and the urea selection reduction catalyst 4 as an ammonium-compound selection reduction catalyst in series, and the urea selection reduction catalyst 4 is NOx. It arranges to the downstream of the occlusion reduction-type catalyst 3.

[0024] With this engine 1, fuel injection duration TAU is computed, for example based on the following formula. TAU=TP-K -- here, TP shows basic fuel injection duration and K shows the correction factor The basic fuel injection duration TP shows fuel injection duration required to make into theoretical air fuel ratio the air-fuel ratio of the gaseous mixture supplied in an engine cylinder. This basic fuel injection duration TP is beforehand found by experiment, and is beforehand memorized in ROM in the form of a map as a function of engine load Q/N (inhalation air-content Q / engine rotational frequency N) and the engine rotational frequency N.

[0025] A correction factor K is a coefficient for controlling the air-fuel ratio of the gaseous mixture supplied in an engine cylinder, and if it is K= 1.0, the gaseous mixture supplied in an engine cylinder will serve as theoretical air fuel ratio (SUTOIKI). On the other hand, if the air-fuel ratio of the gaseous mixture supplied in an engine cylinder will become larger than theoretical air fuel ratio if set to K< 1.0, namely, it becomes RIN and it is set to K> 1.0, the air-fuel ratio of the gaseous mixture supplied in an engine cylinder will become smaller than theoretical air fuel ratio, namely, will become rich.

[0026] And with this engine 1, RIN AFC is performed at a load operating range in engine low, the value of a correction factor K being used as a value smaller than 1.0. SUTOIKI control is performed at the time of the warm-up at the time of engine heavy load operating-range and engine 1 starting, the value of a correction factor K being used as 1.0 at the time of acceleration and fixed-speed operation of 120 or more km/h. In the engine full-load-running field, the value of a correction factor K is set up so that it may consider as a bigger value than 1.0 and rich AFC may be performed.

[0027] in an internal combustion engine, the value of a correction factor K usually makes [in / most in an operating period / the frequency by which low Naka load operation is carried out is the highest, therefore] it smaller than 1.0 -- having -- RIN -- a gaseous mixture is made to burn

[0028] Above NOx The occlusion reduction-type catalyst 3 makes an alumina support, and at least one chosen from an alkaline earth like Potassium K, Sodium Na, Lithium Li, alkali metal like Caesium Cs, Barium Ba, and Calcium calcium, Lanthanum La, and rare earth like Yttrium Y and noble metals like Platinum Pt are supported on this support. An engine inhalation-of-air path and NOx It is NOx about the ratio of the air supplied in the flueway in the occlusion reduction-type catalyst 3 upstream, and fuel (hydrocarbon). It is this NOx when calling the air-fuel ratio of the inflow exhaust gas to the occlusion reduction-type catalyst 3. The occlusion reduction-type catalyst 3 is NOx when the air-fuel ratio of inflow exhaust gas is RIN. NOx which was absorbed, and was absorbed when the oxygen density in inflow exhaust gas fell It emits.

[0029] In addition, NOx When fuel (hydrocarbon) or air is not supplied in the flueway of the occlusion reduction-type catalyst 3 upstream, The air-fuel ratio of inflow exhaust gas is [therefore] in agreement with the air-fuel ratio of the gaseous mixture supplied to a combustion chamber. in this case NOx the time of the air-fuel ratio of the gaseous mixture by which the occlusion reduction-type catalyst 3 is supplied to a combustion chamber being RIN -- NOx the gaseous mixture which absorbs and is supplied to a combustion chamber -- NOx absorbed when the inner oxygen density fell It emits and returns.

[0030] NOx NOx in the occlusion reduction-type catalyst 3 It is thought that absorption and reduction are performed by the mechanism as shown in drawing 2 . Although this mechanism is the case where Platinum Pt and Barium Ba are made to support on support, even if other noble metals, alkali metal, an alkaline earth, and rare earth are used for it, it turns into same mechanism.

[0031] First, since the oxygen density in exhaust gas will increase sharply if exhaust gas becomes remarkable RIN, as it is shown in drawing 2 (A), it is oxygen O2. It adheres to the front face of Platinum Pt in the form of O2- or O2-. Next, NO contained in exhaust gas reacts with O2- or O2- on the front face of Platinum Pt, and is NO2. It becomes (2 NO+O2 ->2NO2).

[0032] Then, generated NO2 NOx NOx of the occlusion reduction-type catalyst 3 As it is absorbed in a catalyst, it

combines with a barium oxide BaO, oxidizing on Platinum Pt unless absorptance is saturated and it is shown in drawing 2 (A), it is NOx in the form of nitrate-ion NO3-. It is spread in the occlusion reduction-type catalyst 3. Thus, NOx NOx It is absorbed in the occlusion reduction-type catalyst 3.

[0033] on the other hand, the case where the oxygen density in exhaust gas falls -- the amount of generation of NO2 -- falling -- a reaction contrary to the aforementioned reaction -- NOx nitrate-ion NO3- within the occlusion reduction-type catalyst 3 -- NO2 or the form of NO -- NOx It is emitted from the occlusion reduction-type catalyst 3.

[0034] That is, NOx It is NOx if the oxygen density in exhaust gas falls. It will be emitted from the occlusion reduction-type catalyst 3. It will be NOx, even if the air-fuel ratio of inflow exhaust gas will be RIN, if the oxygen density in inflow exhaust gas will fall if the RIN degree of inflow exhaust gas becomes low, therefore the RIN degree of inflow exhaust gas is made low, as shown in drawing 3 . The occlusion reduction-type catalyst 3 to NOx It will be emitted.

[0035] the gaseous mixture supplied to a combustion chamber on the other hand at this time -- SUTOIKI -- or it is made rich -- having -- the air-fuel ratio of exhaust gas -- SUTOIKI -- or when it becomes rich, it is shown in drawing 3 -- as -- unburnt [a lot of] -- HC and CO are discharged from an engine 1 unburnt [these] -- HC and CO react immediately with oxygen O2- on Platinum Pt, or O2-, and oxidize

[0036] Moreover, SUTOIKI or since [if it becomes rich,] the oxygen density in exhaust gas will fall to a degree very much, the air-fuel ratio of inflow exhaust gas is NOx. The occlusion reduction-type catalyst 3 is NO2. Or NO is emitted. this NO2 or NO is shown in drawing 2 (B) -- as -- unburnt -- it reacts with HC and CO and is returned NO2 [thus,] on Platinum Pt or -- if NO stops existing -- the degree from the degree from a catalyst -- NO2 Or NO is emitted. Therefore, if the air-fuel ratio of inflow exhaust gas is made rich, it is NOx to the inside of a short time. The occlusion reduction-type catalyst 3 to NOx It is emitted. even if it consumes O2- or O2- on Platinum Pt -- unburnt -- if HC and CO remain -- NOx NOx emitted from the occlusion reduction-type catalyst 3 NOx discharged from the engine 1 unburnt [this] -- it is returned by HC and CO

[0037] Therefore, if the air-fuel ratio of inflow exhaust gas is made rich, it will be NOx to the inside of a short time. NOx absorbed by the occlusion reduction-type catalyst 3 It is emitted and, moreover, is this emitted NOx. Since it is returned, it is NOx in the atmosphere. It can prevent being discharged.

[0038] Moreover, NOx The occlusion reduction-type catalyst 3 is NOx, even if it makes the air-fuel ratio of inflow exhaust gas into theoretical air fuel ratio, since it has the function of a reduction catalyst. NOx emitted from the occlusion reduction-type catalyst 3 It is returned. however, the case where the air-fuel ratio of inflow exhaust gas is made into theoretical air fuel ratio -- NOx NOx from the occlusion reduction-type catalyst 3 gradually -- **** -- since it is not emitted -- NOx the total absorbed by the occlusion reduction-type catalyst 3 -- NOx Long time is required for emitting.

[0039] It will be NOx, even if the air-fuel ratio of inflow exhaust gas will be RIN, if the degree of RIN is made low for the air-fuel ratio of inflow exhaust gas. The occlusion reduction-type catalyst 3 to NOx It is emitted. Therefore, NOx The occlusion reduction-type catalyst 3 to NOx What is necessary is just to make the oxygen density in inflow exhaust gas fall, in order to make it emit.

[0040] Next, the aforementioned urea selection reduction catalyst 4 is NOx. Urea addition performs selection reduction for a catalyst. NOx here A catalyst can illustrate the zeolite catalyst containing the oxide of the transition element of the 4th, 5, and 6 periods, and/or the oxide of rare earth. The catalyst which supported Ti and V to aluminum 2O3 can be illustrated especially preferably.

[0041] If urea solution is added on this catalyst, the nitrogen oxide under a predetermined exhaust-gas temperature and under exhaust air will be returned like the following reaction formulae.

[0042]

(NH2) 2 CO+H2O->2NH3 X+CO2 -- (1)

4NH(s)3X+4NO+O2->4N2+6H2O -- (2)

[0043] NOx explained above In order to operate mutually the occlusion reduction-type catalyst 3 and the urea selection reduction catalyst 4 in complement, at this example, it is NOx. To the upstream of the urea selection reduction catalyst 4, it is NOx at the downstream of the occlusion reduction-type catalyst 3. It has the sensor 5 and the urea addition control valve 6. NOx A sensor 5 is NOx. It is the direct downstream of the occlusion reduction-type catalyst 3, and is located in the upstream of the urea addition control valve 6. Moreover, while the catalyst close gas-temperature sensor 7 is arranged at the right above style side of the urea selection reduction catalyst 4, the ammonia sensor 8 is arranged at the downstream of the urea selection reduction catalyst 4.

[0044] NOx The sensor 5, the urea addition control valve 6, the catalyst close gas-temperature sensor 7, and the ammonia sensor 8 are electrically connected to the control unit (ECU) 9 which consists of a computer, respectively. Furthermore, the rotational frequency sensor for detecting an engine rotational frequency is formed, and this sensor is

also connected to the control unit (ECU) 9.

[0045] As for state ****** of each catalyst, the operational status of an internal combustion engine is detected by the information from these sensors etc. And an operational status detection means 10 to detect the operational status of an internal combustion engine from the data inputted from these sensors etc. is realized on the computer of the aforementioned control unit (ECU) 9. Furthermore, while taking out urea addition instructions to the aforementioned urea addition control valve 6 according to the detected operational status, the urea addition control means 11 which control an addition are also realized on the computer of the aforementioned control unit (ECU) 9. In addition, when a urea is added by the urea addition control means 11, the reducing-agent indicator 12 displayed on an operator is formed [that the it is under addition, and] in 13, such as a meter panel.

[0046] NOx A sensor 5 is Above NOx. NOx in close gas, the NOx concentration 4, i.e., the urea selection reduction catalyst, in the exhaust gas which went via the occlusion reduction-type catalyst 3, Concentration is detected. The aforementioned urea addition control means 11 are NOx. NOx detected by the sensor 5 NOx discharged from an internal combustion engine by concentration and the air content detected by the air flow meter which is not illustrated NOx which calculated the amount and was calculated It has an amount determination means of addition ureas to presume the amount of ureas which should be added from an amount to the urea selection reduction catalyst 4, and it orders so that the urea of the amount according to the estimate may be added.

[0047] NOx detected here in order to presume the amount of ureas It is good to make ROM memorize the map which defined beforehand the relation between an amount and the amount of ureas which should be added. In addition, NOx The amount of EGR(s) according to accelerator opening as a result fuel oil consumption, an engine rotational frequency, and an EGR control unit instead of a sensor 5 etc. to NOx You may presume an amount. Moreover, the inhalation air content of an internal combustion engine is good in other meanses replaced with detection with an air flow meter, for example, throttle opening etc.

[0048] The catalyst close gas-temperature sensor 7 can function as a degree detection means of catalyst temperature to detect the temperature of the exhaust gas which flows into the urea selection reduction catalyst 4, and can judge the activated state of the urea selection reduction catalyst 4 from this temperature. The decontamination-capacity force of a catalyst is a low and, as for the time of a low, the close gas temperature to this catalyst reduces a urea addition in the urea addition control means 11. In addition, the relation between the close gas temperature (the degree of catalyst temperature) to a catalyst and a urea addition is beforehand memorized to ROM as a map.

[0049] The ammonia sensor 8 is used for amendment of a urea addition. That is, it is NOx that the ammonia sensor 8 in the downstream of the urea selection reduction catalyst 4 detects ammonia. More than an amount, it means that there are too many added ureas. For this reason, it has a feedback control means to feed back the amount of ammonia detection detected by the ammonia sensor 8 to the urea addition control means 11, and to correct to proper desired value the amount of ureas which should be added. These control means are also realized on the computer of a control unit (ECU) 9 as some urea addition control means 11.

[0050] Hereafter, the exhaust air purification control depended on this example is explained. If an internal combustion engine is operated, when fuel burns within a cylinder, the gas which exhaust gas was discharged and was discharged flows the inside of an exhaust pipe 2, and is NOx. It passes along the muffler which passes one by one and does not illustrate the occlusion reduction-type catalyst 3 and the urea selection reduction catalyst 4, and is emitted to the atmosphere.

[0051] At this example, it is NOx. Exhaust air purification in the largest possible field is performed because the urea selection reduction catalyst 4 functions in the engine operating range of the heavy load quantity rotation beyond the purification field in the occlusion reduction-type catalyst 3.

[0052] First, it is NOx when it is not a predetermined heavy load quantity rotation field. It is NOx at the principle described above in the occlusion reduction-type catalyst 3. Occlusion and reduction change, and are carried out and exhaust air purification is performed. Namely, NOx The occlusion reduction-type catalyst 3 to NOx When emitted, the air-fuel ratio of inflow exhaust gas is made rich, and it is NOx. NOx emitted in the occlusion reduction-type catalyst 3 It returns.

[0053] On the other hand, if a throttle is extracted, an inhalation air content is reduced and an air-fuel ratio is made rich when an internal combustion engine becomes predetermined heavy load quantity rotation, it will originate in an inhalation air content (the amount of oxygen) becoming less, fuel will be in an unburnt state, and the so-called smoke will occur. Therefore, at the operating range of predetermined heavy load quantity rotation, it is NOx. NOx depended occlusion reduction-type catalyst 3 It cannot return.

[0054] Then, in response to the fact that the operational status detection means 10 detected that it was such a operating range, the urea addition control means 11 take out urea addition instructions to the aforementioned urea addition control valve 6. From the urea addition control valve 6, urea solution is injected and, thereby, exhaust air purification is

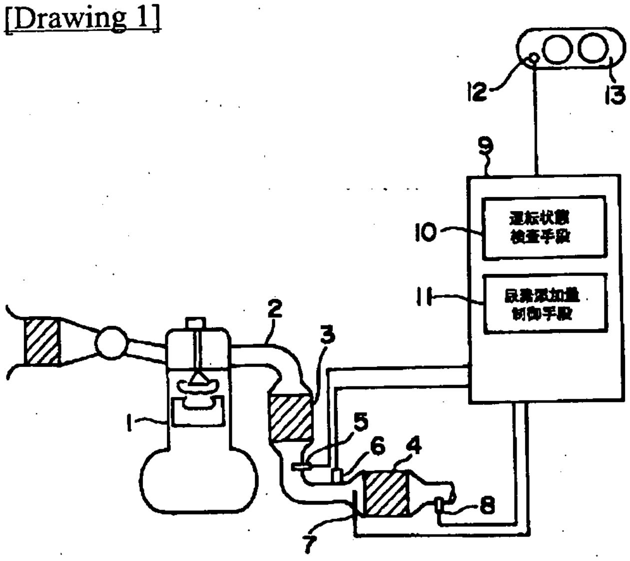
made by the above-mentioned principle.
[0055] It is NOx in the meantime. By the sensor 5, it is NOx. NOx blown without being purified with the occlusion reduction-type catalyst 3 Concentration is detected, this detection value is received and the urea addition control means 11 of a control unit (ECU) 9 are NOx. Concentration, NOx discharged from an internal combustion engine by the inhalation air content to an internal combustion engine An amount is calculated, the amount of ureas which should be added from the value to the urea selection reduction catalyst 4 is presumed by the amount determination means of addition ureas, and the urea addition control valve 6 is ordered so that the urea of the amount according to the estimate may be added.
[0056] Moreover, the close gas temperature to the urea selection reduction catalyst 4 is measured by the catalyst close gas-temperature sensor 7, and a urea addition is fluctuated in the urea addition control means 11 of a control unit (ECU) 9 according to the height of the detection value.
[0057] Furthermore, the feedback control [in / the urea addition control means 11 / in response to this detection value / it came out and the ammonia concentration in gas is detected, and] means to which the ammonia sensor 8 passed the urea selection reduction catalyst 4 corrects the amount of addition ureas in the direction whose ammonia concentration in the exhaust gas which passed the urea selection reduction catalyst 4 decreases.
[0058] Thus, NOx Although exhaust air purification is performed by the occlusion reduction-type catalyst 3 and the urea selection reduction catalyst 4, it is NOx here. The complementary relationship of the exhaust air purification by the occlusion reduction-type catalyst 3 and the urea selection reduction catalyst 4 is shown in drawing 4 . (A) in drawing 4 is NOx. The field by the occlusion reduction-type catalyst 3 which can be purified is shown, and (B) in drawing 4 shows the field by the urea selection reduction catalyst 4 which can be purified.
[0059] Moreover, it is NOx to drawing 5 . The relation of the exhaust-gas temperature and the rate of purification in the occlusion reduction-type catalyst 3 and the urea selection reduction catalyst 4 is shown. (A) of drawing 5 is NOx. The field by the occlusion reduction-type catalyst 3 which can be purified is shown, and (B) in drawing 4 shows the field by the urea selection reduction catalyst 4 which can be purified. It is NOx in the field where an exhaust-gas temperature is low so that clearly from drawing 5 . It is understood that the occlusion reduction-type catalyst 3 functions and the urea selection reduction catalyst 4 functions in the field where an exhaust-gas temperature is high.
[0060] In addition, it sets in this operation form and is NOx. You may exchange the position of the occlusion reduction-type catalyst 3 and the urea selection reduction catalyst 4.
[0061] Other operation forms are explained according to the <operation form 2>, next drawing 6 . In drawing 6 , it is the composition which equipped with the start cat 21 further the composition shown with the operation form 1. The start cat 21 is NOx prepared in the exhaust pipe 2 possible near an internal combustion engine. It is the thing of a catalyst and is NOx at the time of engine starting. NOx taken out from an internal combustion engine before the occlusion reduction-type catalyst 3 is warmed It purifies. The start cat 21 is NOx. Since it is arranged in the preceding paragraph of the occlusion reduction-type catalyst 3 at the portion near an internal combustion engine, it is promptly heated with exhaust gas at the time of an engine's starting, and a temperature up is carried out to a purification field.
[0062] In addition to the composition shown in drawing 1 , the exhaust emission control device shown in this operation form as shown in <operation form 3> drawing 7 is NOx arranged at the upstream. It has the bypass way 31 which bypasses the occlusion reduction-type catalyst 3 and shows exhaust gas to the catalyst of a downstream.
[0063] The change-over valve 32 which switches an exhaust air gas stream by opening and closing the bypass way 31 as means for switching is formed in the branch point of an exhaust pipe 2 and the bypass way 31.
[0064] This change-over valve 32 is a solenoid valve which is electrically connected to the aforementioned control unit (ECU) 9, and is controlled. And a change-over valve 32 is NOx by the operational status detection means 10. When it is the operating range on which the occlusion reduction-type catalyst 3 functions, the bypass way 31 is closed, and it is NOx. It is made for exhaust gas to flow to the occlusion reduction-type catalyst 3. Moreover, it is NOx, while detecting this state and opening the bypass way 31 by the change-over valve 32, when an internal combustion engine will be in the operational status of heavy load quantity rotation. The exhaust air gas passageway to the occlusion reduction-type catalyst 3 is shut, and it is made for exhaust gas to have flowed into the direct urea selection reduction catalyst 4 from the bypass way 31.
[0065] Therefore, when the operational status of the internal combustion engine detected with the operational status detection means 10 is not heavy load quantity rotation, A change-over valve 32 closes the bypass way 31 by the instructions from a control unit, and exhaust gas is poured to the NOx occlusion reduction-type catalyst 3. When the operational status of the internal combustion engine detected with the operational status detection means 10 is heavy load quantity rotation, a change-over valve 32 opens the bypass way 31 by the instructions from a control unit, and it is NOx. The exhaust air gas passageway to the occlusion reduction-type catalyst 3 is shut, and exhaust gas is poured from the bypass way 31 to the direct urea selection reduction catalyst 4. In response to the fact that the operational status

detection means 10 detected that it was such a operating range, the urea addition control means 11 take out urea addition instructions to the aforementioned urea addition control valve 6. From the urea addition control valve 6, urea solution is injected and, thereby, exhaust air purification is made by the above-mentioned principle.
[0066] A flueway is made to branch to the 1st parallel flueway 41 and 2nd parallel flueway 42 mutually, and the exhaust emission control device shown in this operation form as shown in <operation form 4> drawing 8 is NOx to the 1st flueway 41. It is the composition which has arranged the occlusion reduction-type catalyst and has arranged the urea selection reduction catalyst 4 to the 2nd flueway 42.
[0067] And the change-over valve 32 is arranged as the aforementioned means for switching to the branch point of the 1st flueway 41 of the above, and the 2nd flueway 42. And it is NOx like the composition shown in drawing 1 . While the sensor 5 is formed in the upstream of urea selection reduction-catalyst 4 **, the catalyst close gas-temperature sensor 7 is formed in the right above style side of the urea selection reduction catalyst 4, and the ammonia sensor 8 is formed in the downstream of the urea selection reduction catalyst 4. Furthermore, the urea addition control valve 6 is formed in the right above style side of the urea selection reduction catalyst 4.
[0068] The aforementioned change-over valve 32 is a solenoid valve which is electrically connected to the aforementioned control unit (ECU) 9, and is controlled. And a change-over valve 32 is NOx by the operational status detection means 10. When it is the operating range on which the occlusion reduction-type catalyst 3 functions, the 1st flueway 41 is chosen, and it is NOx. It is made for exhaust gas to flow to the occlusion reduction-type catalyst 3. NOx Exhaust air purification with the occlusion reduction-type catalyst 3 is as having described above.
[0069] Moreover, when an internal combustion engine will be in the operational status of heavy load quantity rotation, this state is detected, a change-over valve 32 chooses the 2nd flueway 42, and it is made for exhaust gas to have flowed into the urea selection reduction catalyst 4. When the urea selection reduction catalyst 4 is chosen, the urea addition control means 11 take out urea addition instructions to the aforementioned urea addition control valve 6. From the urea addition control valve 6, urea solution is injected and, thereby, exhaust air purification is made by the above-mentioned principle.
[0070] Form] of operation of others [[ ] Although the example applied to the gasoline engine 1 explained this invention with the form of operation mentioned above, of course, this invention is applicable to a diesel power plant. In the case of a diesel power plant, since combustion in a combustion chamber is performed in a RIN region farther than SUTOIKI, at the usual engine operational status, it is NOx. The air-fuel ratio of the exhaust gas which flows into the occlusion reduction-type catalyst 3 is very RIN, and NOx. Although absorption is performed, discharge of NOx is hardly performed.
[0071] Then, they are SUTOIKI or NOx which makes it rich and is absorbed by the catalyst about the air-fuel ratio of exhaust gas by introducing exhaust-gas-recirculation equipment (the so-called EGR equipment), for example, and introducing exhaust-gas-recirculation gas into a combustion chamber so much by the diesel power plant. It can be made to emit.
[0072]
[Effect of the Invention] NOx which according to the exhaust emission control device of the internal combustion engine of this invention complements an exhaust air purification field mutually and suits Since it had the occlusion reduction-type catalyst and the ammonium-compound selection reduction catalyst, exhaust air purification by the largest possible operating range can be performed.
[0073] It has an operational status detection means to detect the operational status of an internal combustion engine here, the operational status of an internal combustion engine is followed, and it is Above NOx. By switching an exhaust air gas stream to either of an occlusion reduction-type catalyst and an ammonium-compound selection reduction catalyst by means for switching, the optimal catalyst can be chosen according to operational status.
[0074] Furthermore, NOx in the exhaust gas which flows into the aforementioned ammonium-compound selection reduction catalyst by the amount determination means of addition ammonium compounds From an amount and the inhalation air content of an internal combustion engine, the amount of ammonium compounds which should be added to an ammonium-compound selection reduction catalyst can be determined easily.
[0075] And the ammonium compound which flows out of an ammonium-compound selection reduction catalyst is detected with an ammonium-compound detection means, if the amount of ammonium compounds which should be added from this detected amount of ammonium-compound detection is corrected to a proper addition by control means, the amount of addition ammonium compounds can be controlled more to accuracy, and more effective exhaust air purification can be performed.

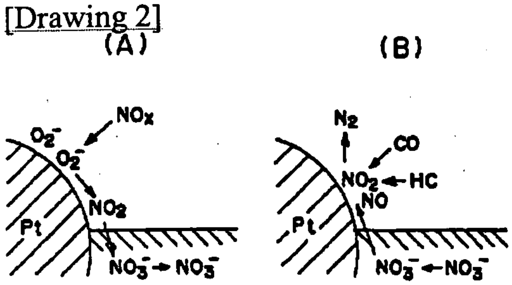
[Translation done.]

DRAWINGS

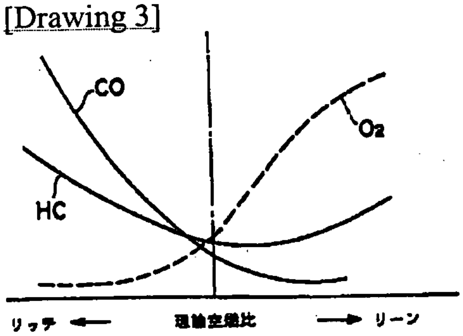
[Drawing 1]



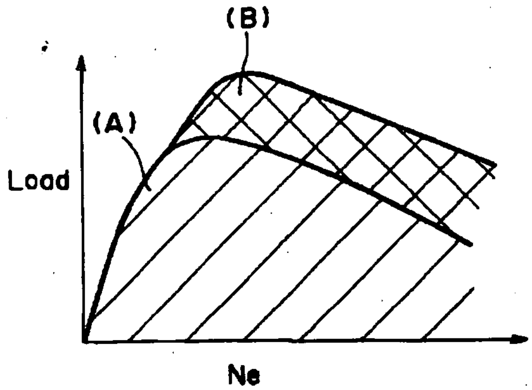
[Drawing 2]



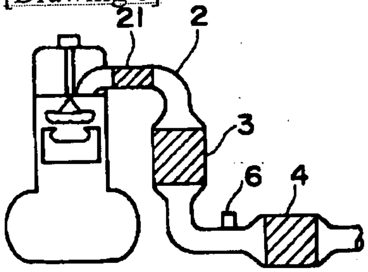
[Drawing 3]



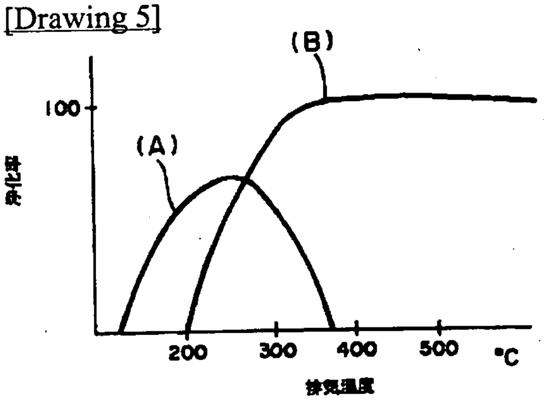
[Drawing 4]



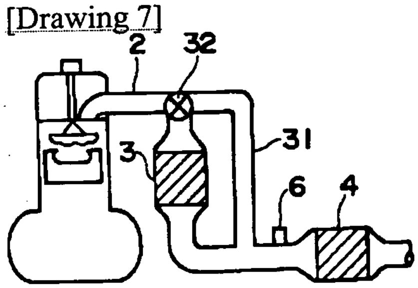
[Drawing 6]



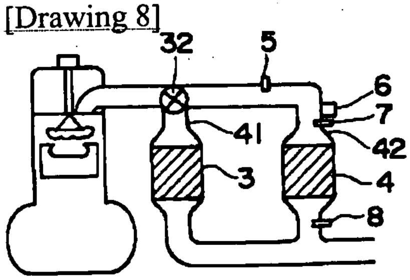
[Drawing 5]



[Drawing 7]



[Drawing 8]



[Translation done.]